Feature Extraction of Defects on Wood Surface[1]

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Abstract The computer image processing technology was used to accomplish the feature extraction of defect images on wood surface. By calculation of gray values of defects, three feature data which are useful to identify the defects have been achieved. The experiment indicates that this way is effective to the automation recognition of the defects on wood surface.
Key words: Binarilization, Gray image, Feature extraction

Introduction

At present, using the computer image processing system to finish the feature extraction of wood defects is in an exploratory stage. This method may decrease the limitation of the experimental conditions, such as lights, instruments and some special materials. It is convenient to use this way and the good results will be achieved.

There are three typical wood surface defects to be studied in the experiment, which are knot, borehole and decay of *Larix* and *Betula*. The work is to separate the defects from the wood surface images and provide a good base for accomplishing recognition of defects.

Components of System

The computer image processing system is shown in Fig. 1. It is comprised of several major components: computer, image processing module, a 600 lines machine camera and an industry monitor.

Image Processing and Feature Extraction

The image processing is a series of specified operations to remake the images according to the specified aims. In this paper, the specified aim is the processing to accomplish the changes from collected images to defect images. The original image was collected by the industry camera and changed into digital image by the image processing module. The digital image is a bitmap which is comprised of 512×512 points with values of 256 gray levels. The Fig. 2 is the original images of four types of defects.

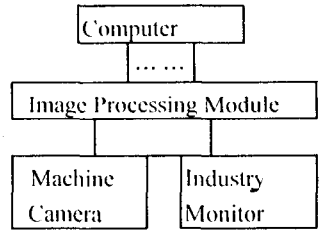


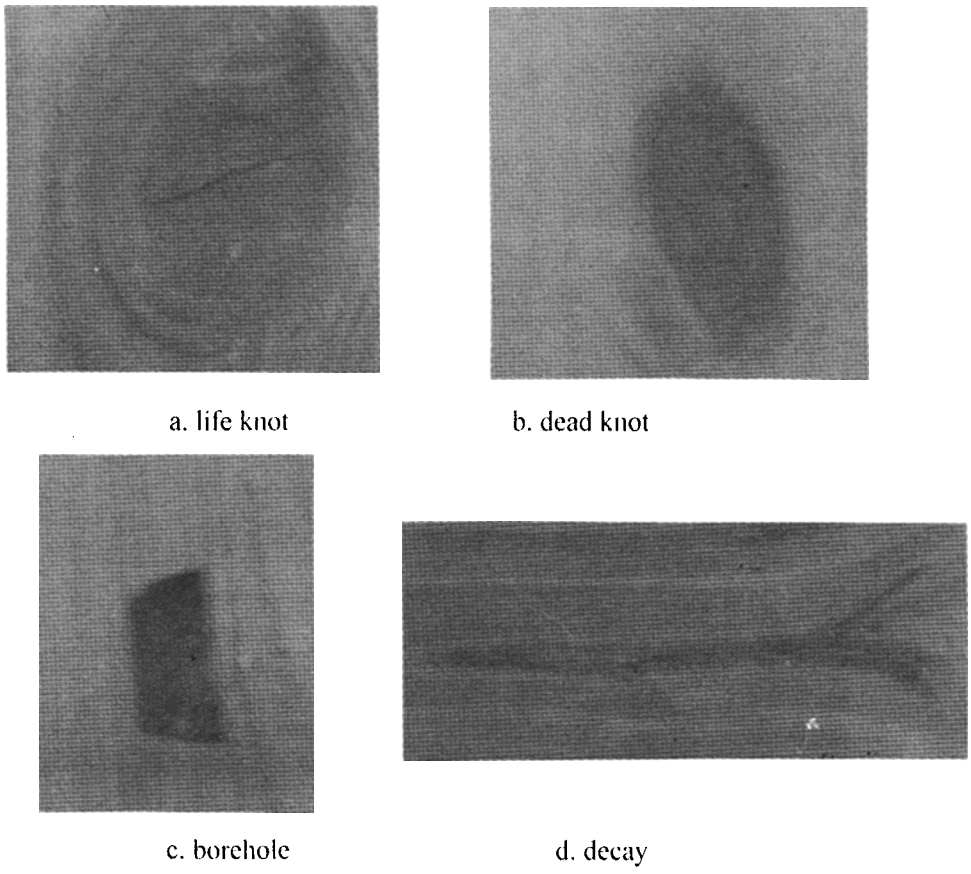
Fig. 1. Components of computer image processing system

The binarilization of conditional threshold

The binarilization is the image processing which transforms the gray images into a image only with two gray values (0 : black and 255 : white) according to the fixed threshold (The arbitrary value from 0 to 255). The aim of binarilization is to reflect the changing pattern of defect images clearly. With the experiences of selecting appropriate thresholds, we can extract the defects from the wood surface images. This must be convenient to

[1] This study was supported by the Chinese Natural Sciences Foundation.

define the shape, position and size of the defects. Using this method to reflect the defects is only because there is an enormous contrast between defect and wood surface. Selection of threshold is very important for the different defects. In our experiment, we use two different thresholds to binarilize the images, one for the defects with the great change of gray, and another for the defect with unclear change. We also study the effects of grain changes. We use the special way to filter out the grains from the binarlized image. The final binarilized images of four types of defects are shown in Fig. 3.



a. life knot b. dead knot

c. borehole d. decay

Fig. 2. The original images of four types of defects

Feature extraction of defects

After the image processing, we use the binarilized images to define the size and position of defects. The extracted gray images of defects are shown in Fig. 4. Then the gray values of defects are extracted. We can achieve the gray features according to the following equations:

$$X_1 = \frac{\sum_{i=0}^{L}\sum_{j=0}^{W} G[i][j]}{n} \quad (1)$$

$$X_2 = \frac{\sum_{i=0}^{L}\sum_{j=0}^{W} (G[i][j] - X_1)^2}{n} \quad (2)$$

$$X_3 = \frac{L}{W} \quad (3)$$

where:

X_1--the average of gray values in defects;

X_2--the variance of gray values in defects;

X_3--the rate of length to width of defects;

L--the length of defects;

W--the width of defects.

The averages of these features are given in Table 1.

Table 1. The averages of three feature data of four types of defects

	Average of gray values	Variance of gray values	Rate of length to width
life knot	86.077	60.923	0.936
dead knot	61.472	143.716	0.874
borehole	50.401	70.485	0.458
decay	52.955	90.778	4.381

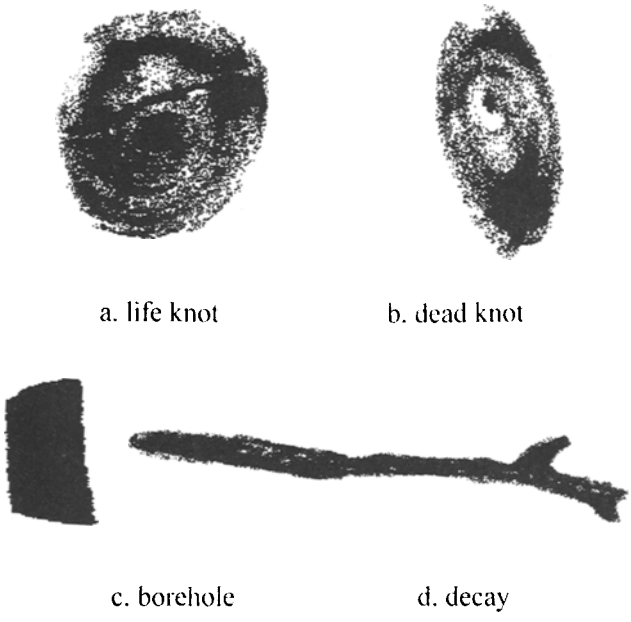


Fig. 3. The binarilized images of four types of defects

Conclusion

The computer image processing and feature extraction are the effective method to achieve the feature data of wood surface defects. We can also use these feature data to accomplish defects automation recognition. So this method is the good idea to the study of wood surface defects.

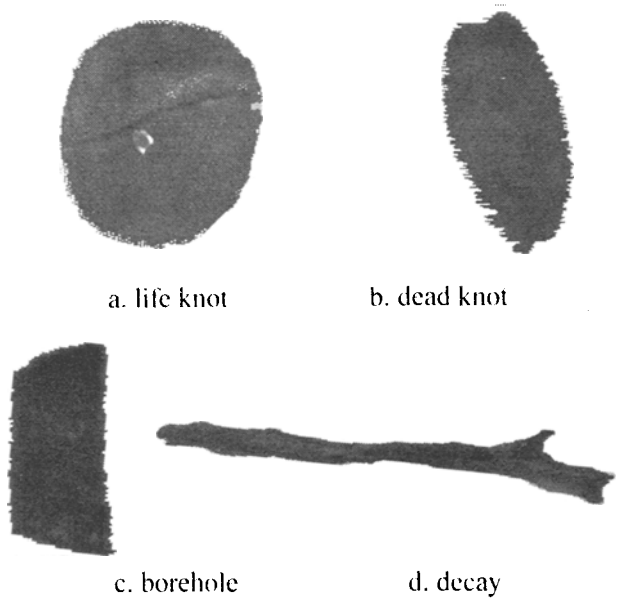


Fig. 4. The extracted gray images of four types of defects

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(Responsible Editor: Dai Fangtian)